

**DESCRIPTION OF THE IMMATURE STAGES OF *PYRODERCES BADIA*
(HODGES) (LEPIDOPTERA: COSMOPTERIGIDAE), WITH A NEW HOST
RECORD FROM LOUISIANA**

DAVID ADAMSKI, JOHN W. BROWN, AND WILLIAM H. WHITE

(DA, JWB) Systematic Entomology Laboratory, PSI, Agricultural Research Service, U.S. Department of Agriculture, % National Museum of Natural History, Smithsonian Institution, P.O. Box 37012, MRC 168, Washington, D.C., 20013-7012, U.S.A. (e-mail: dadamski@sel.barc.usda.gov; jbrown@sel.barc.usda.gov); (WHW) Southern Regional Research Center, Sugarcane Research Unit, 5883 USDA Road, Houma, LA, 70360, U.S.A. (e-mail: wwwhite@srcc.ars.usda.gov)

Abstract.—The last larval instar and pupa of *Pyroderces badia* (Hodges) are described and illustrated based on specimens collected from seed heads of sorghum (*Sorghum bicolor* (L.) Moench) (Poaceae) in southern Louisiana. The species is a well-known scavenger on a wide array of plant material.

Key Words: Cosmopterigidae, Gelechioidea, scavenger, *Sorghum*

The cosmopterigid genus *Pyroderces* Herrich-Schäffer includes more than 80 species in the tropical, subtropical, and warm temperate parts of the world, with greatest species richness in Australia and the Old World tropics (Hodges 1978). Observations on the early stages suggest that larvae are most likely scavengers on a wide array of plant material. The larvae of *Pyroderces* frequently are intercepted at U.S. ports-of-entry, associated most often with pineapple (*Ananas comosus* (L.) Merr.) (Bromeliaceae), and less often with corn (*Zea mays* L.) (Poaceae), bananas (*Musa* spp.) (Musaceae), and guava (*Psidium guajava* L.) (Myrtaceae). The U.S. Department of Agriculture, Systematic Entomology Laboratory database includes nearly 150 records of interceptions over the last 15 years, primarily from Central America and the Caribbean (Robert W. Carlson, personal communication).

Pyroderces badia (Hodges, 1962) (Fig. 1) is a widespread species of the eastern

seaboard, ranging from Washington, D.C., south to Florida (and possibly the Caribbean), and west to Louisiana (Hodges 1962, 1978). According to Hodges (1978), the species also is represented by highly disjunct, probably adventitious (invasive) populations in southern California and Hawaii. Like most species of *Pyroderces*, the larvae of *P. badia* are scavengers, having been reared from seed pods of coffee senna (*Cassia occidentalis* L.) (Fabaceae); peach (*Prunus persica* (L.) Bastch) (Rosaceae) and loquat (*Eriobotrya japonica* (Thunb.) Lindl.) (Rosaceae) mummies; fruits of lime (*Citrus aurantiifolia* (L.) Swingle) (Rutaceae), grapefruit (*Citrus* × *paradisi* Macfad.) (Rutaceae), and bananas; cabbage (*Brassica oleracea* L.) (Brassicaceae); coconut blossoms (*Cocos nucifera* L.) (Arecaceae); elm leaves (*Ulmus* spp.) (Ulmaceae); and cones of pine trees (i.e., *Pinus elliottii* Engelm., *P. palustris* Mill., *P. pinaster* Aiton) (Pinaceae) (Hodges 1962, 1978). Although frequently observed, the early stages previ-

ously have not been described or illustrated. While conducting field surveys in Louisiana in 2002, we discovered larvae of *P. badia* feeding in the flower heads of live sorghum, *Sorghum bicolor* (L.) Moench (Poaceae); we reared adults and preserved examples of the early stages. We take this opportunity to describe and illustrate the last instar larva and pupa of *P. badia* and compare the larva with that of *P. rileyi* (Walsingham).

MATERIALS AND METHODS

Seed heads of sorghum (*Sorghum bicolor* (L.) Moench) (Poaceae) infested with larvae of *Pyroderces badia* were collected in Avoyelles Parish (29.4525°N, 90.2777°W), Louisiana, on 2 August 2002, and brought into the laboratory for examination. Fifteen larvae were removed, boiled in H₂O, and preserved in 70% EtOH. The remaining larvae were allowed to complete larval development and pupate. Pupae were collected periodically (n = 21) and preserved in 70% EtOH. The remaining pupae were allowed to complete development. Newly emerged adults were frozen and later spread and double-mounted.

For study using electron microscopy, larvae and pupae were cleaned in 10% EtOH with a camel's-hair brush and dehydrated in increasing concentrations of EtOH to absolute EtOH. After dehydration, specimens were critical-point dried using a Tousimis critical point dryer, mounted on stubs, and coated with gold-palladium (40–60%) using a Cressington sputter coater. The ultrastructure of the larvae and pupae was studied with an Amray scanning electron microscope.

Gross morphological observations and measurements of the larvae and pupae were made using a dissecting microscope (reflected light) with a calibrated micrometer. Maps of the larval chaetotaxy were initially drawn using a WILD dissecting microscope with a camera lucida attachment. Terminology for chaetotaxy follows Stehr (1987). All vouchers (larvae, pupae, and adult spec-

imens) are deposited in the National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C. Larval specimens of *Pyroderces rileyi* were examined from the larval alcohol collection at USNM.

RESULTS

Pyroderces badia (Hodges) (Figs. 1–13)

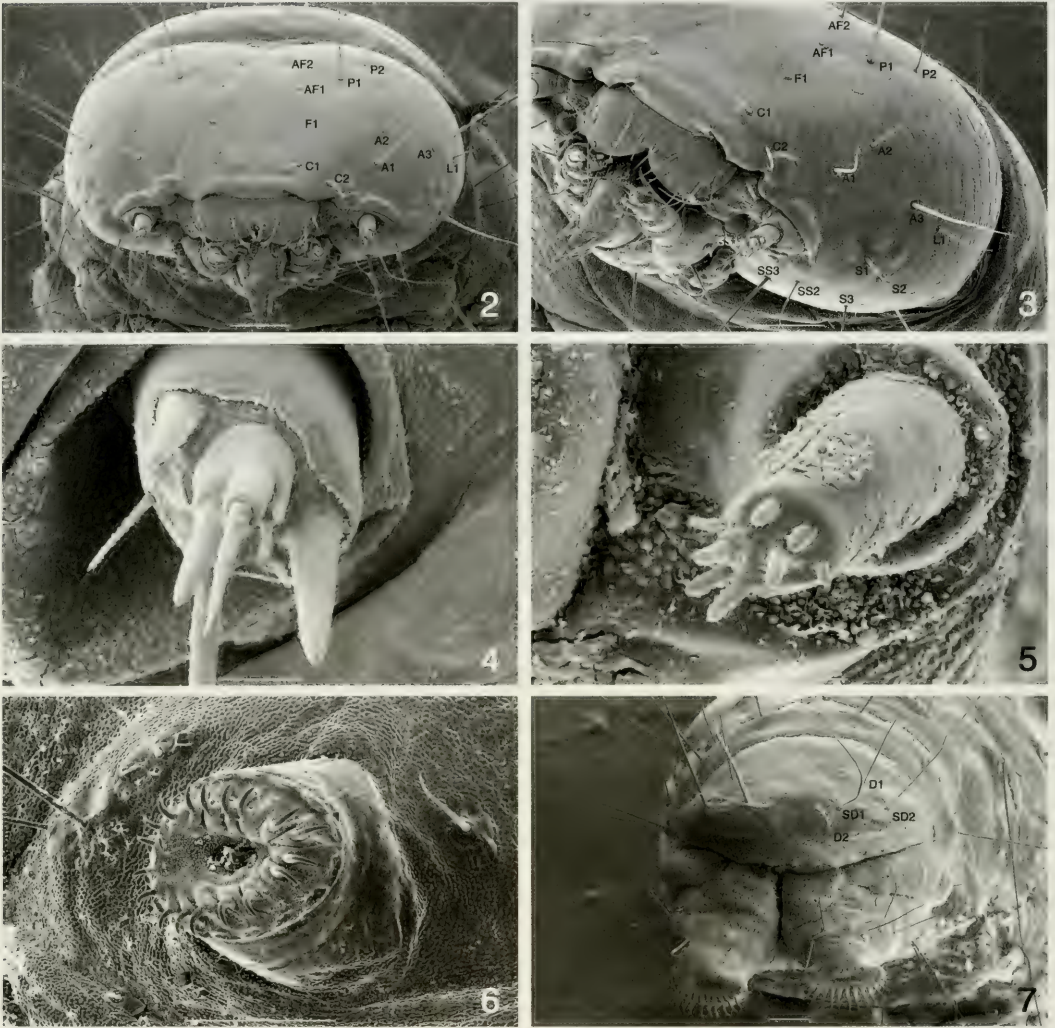
Last Instar larva (Figs. 2–11).—Length 6.0–8.5 mm, mean = 7.4 mm (n = 15). Body pale brownish gray with a trace of pink (live specimens pink); integument apparently smooth under light microscopy, granular under SEM at magnifications above 200×; epicranium, prothoracic shield, and L-group pinaculum slightly darker than anal plate; pinacula slightly darker than body; thoracic legs concolorous with body; spiracles on T1 and A8 about equal in size, twice diameter of spiracles on A1–A7. *Head* (Figs. 2, 3): Hypognathous, adfrontal sclerites narrow, meeting dorsally between lateral hemispheres of epicranium; coronal suture absent; AF-group setae on apical half of adfrontal sclerites, AF2 near apex, about equidistant to AF1 as AF1 is to F1; AF1 and AF2 slightly longer than F1; P1 dorsolaterad to AF1, about 3–4 times as long as P2; C1 beneath and slightly anterad to F1, C2 above base of mandible, slightly longer than C1; mandible (Fig. 10) with 5 dentiform processes, and bearing 2 subequal setae; maxilla and antenna with sensillar types and arrangement as figured (Figs. 4–5); 6 stemmata in a semicircular array, with stemma III and IV proximate; setae associated with stemmata in genal area illustrated in Fig. 3. *Thorax* (Fig. 8): Prothoracic shield with XD1 and D2 along anterior margin, SD1 along anterolateral margin; XD2 closer to SD1 than to XD1; XD1 about equal in length to XD2; SD1 about twice as long as XD1 and XD2; SD2 equally distant from XD2 and SD1, forming a triangular array within anterolateral angle; D1 posteriorad to XD1, both setae



Fig. 1. Adult of *Pyroderces badia*.

parallel to median longitudinal axis, D1 and D2 in straight line perpendicular to axis; D2 and SD1 about equal in length; D1 and SD2 about equal in length and about $\frac{1}{2}$ as long as XD1 and XD2. L-group pinaculum subrectangular and anterior to spiracle; L2 beneath L1, both anterior to L3; L2 about twice as long as L1 and at least 3 times as long as L3. SV-group bisetose, SV2 about $\frac{3}{4}$ as long as SV1. Distance between coxae of T1 about $\frac{1}{4}$ distance of that between coxae on T2-T3; V-group setae on T1-T2 2-3 times farther apart than on prothorax. T1-T2 (Fig. 8) with D1 and D2 on same pinaculum; D2 about 3 times as long as D1; SD1 and SD2 on same pinaculum, slightly anterior to D-group pinaculum, SD1 about 2 times as long as SD2 and about equal in length to D2; L1 and L2 on same pinaculum, L1 about equal in length to D2 and SD1, and about $\frac{2}{3}$ times as long as L2 and about 3 times as long as L3; SV-group unisetose, SV1 posterior to L3. *Abdomen* (Figs. 9, 11): A1-A2 (Fig. 9) with D2 about 2.5 times as long as D1; SD1 above spiracle, about equal in length to D2; L1 and L2

on same pinaculum, slightly anterior of spiracle; L2 about $\frac{1}{2}$ as long as L1; L3 in vertical line with D2, about $\frac{3}{4}$ as long as SD1 and D2; SV-group trisetose, SV2 about 3 times as long as SV1 and SV3; V-group setae slightly farther apart than V-group setae on A3-A6. A3-A6 (Fig. 11) with SD1 dorsoanterior to spiracle, in approximate straight line with D1 and pinaculum bearing L1-L2; SV-group trisetose, SV1 about 2 times as long as SV3 and at least 3 times as long as SV2; proleg with uniserial crochets, long mesally, gradually shortened along lateral margin. A7 with SV-group bisetose, SV1 about 2 times as long as SV2. A8 with D2-pinaculum large, but not as large as D2-pinaculum on A9; SD1 anteroventral to spiracle; SV-group unisetose, SV1 slightly shorter than L3. A9 with D2 pinaculum the largest of abdomen; D2 in line with SD1, with D1 slightly anterior; D2 about equal in length to SD1, both setae about 5 times as long as D1; L1-L2 on same pinaculum, L1 about 3 times as long as L2; L2 slightly longer than D1 and L3; D1 about equal in length to L3. A10 with anal

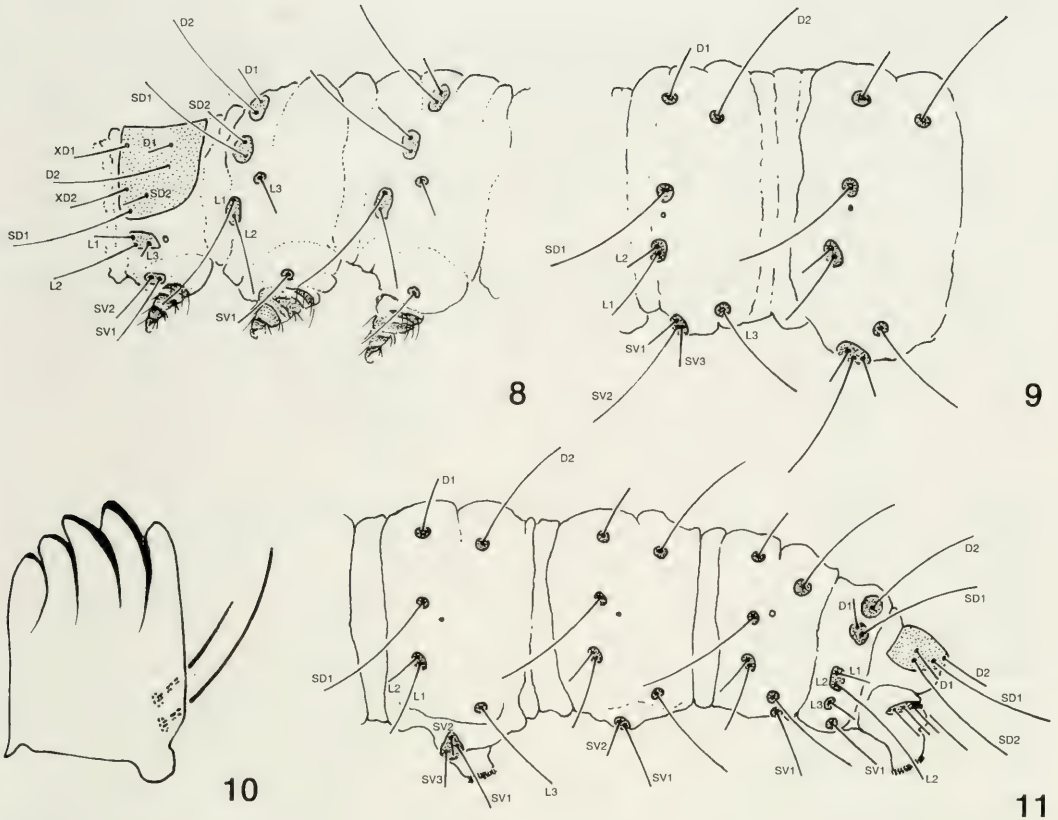


Figs. 2-7. Scanning electron micrographs of the larva of *Pyroderces badia*. 2, Head, frontal view (scale = 100 μ). 3, Head, ventrolateral view (scale = 100 μ). 4, Maxillary palpus (scale = 10 μ). 5, Antenna (scale = 10 μ). 6, Abdominal proleg (scale = 100 μ). 7, Anal plate (scale = 100 μ).

plate with D2, SD1, and SD2 along outer margin, SD1 closer to D2 than to SD2; D1 slightly anterior to SD2; SD2 about equal in length to SD1, both about twice as long as D2; D2 slightly longer than D1; prolegs (Fig. 6) bearing crochets in curved line, with large crochets medially, gradually decreasing in size mesially and laterally.

Pupa (Figs. 12, 13).—Length 3.5–4.5 mm, mean = 4.0 mm (n = 21). Body smooth; spiracles protuberant; terminal six

abdominal segments articulate as a unit; ventral surface of posteroapical part of abdomen with 5 pairs of setae with hooked apices, dorsal surface of posteroapical part of abdomen with 4 pairs of setae with hooked apices, tergum-9 with 2 setal pairs with hooked apices; tergum-8 with 2 setal pairs with hooked apices; and tergum-7 with 1 setal pair with hooked apices on posterior half; other abdominal terga with setae without hooked apices.



Figs. 8–11. Chaetotaxy of larva of *Pyroderces badia*. 8, Thoracic segments (1–3). 9, Abdominal segments 2–3. 10, Manible. 11, Abdominal segments 6–10.

DISCUSSION

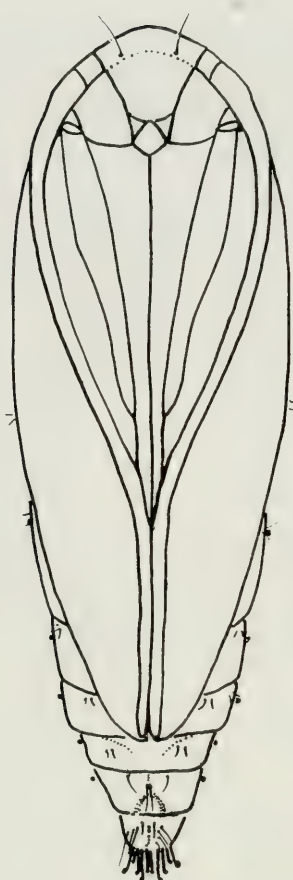
In his catalog of the Cosmopterigidae, Sinev (2002) recently transferred both *P. badia* and *P. rileyi* to *Anatrachynthis*. This action, however, was not explained and has received little support. Hence, we have taken a conservative approach and continue to treat these two North American species as members of *Pyroderces* until more compelling evidence is presented to the contrary.

Stehr (1987) figured the head, thorax, one of the proleg-bearing abdominal segments, and the crochet arrangement of *Pyroderces rileyi* (original illustrations from Peterson 1948), a sympatric congener of *P. badia*. Although generally adequate, a few inaccuracies in the drawing are noted here, based on the examination of specimens in the USNM collection. The pinacula are not

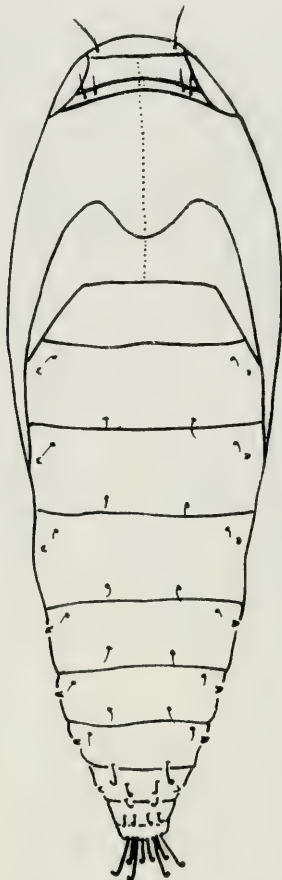
shown; the setae are much too short; the placement of L3 and SV1 on T1 is too anterior; and the crochets should be uniserial, long mesally, gradually shortened along the lateral margin. Although several larvae of *Pyroderces rileyi* were examined, we could find no diagnostic characters to reliably differentiate them from the larvae of *P. badia*.

ACKNOWLEDGMENTS

We thank James F. DiLoreto, Office of Imaging and Photographic Services, Smithsonian Institution, Washington, D.C., for the digital processing and preparation of the plates. Robert W. Carlson, USDA Systematic Entomology Laboratory (SEL), provided statistics on interceptions of *Pyroderces* from the SEL database. We thank the following for reviewing the manuscript: Lauri



12



13

Figs. 12-13. Pupa of *Pyroderces badia*. 12, Ventral view. 13, Dorsal view. Scale = 1.0 mm.

Kaila, Finnish Museum of Natural History, University of Helsinki, Finland, and Michael Gates and Thomas J. Henry, SEL, USDA, National Museum of Natural History, Washington, DC.

LITERATURE CITED

Hodges, R. W. 1962. A revision of the Cosmopterigidae of America north of Mexico, with a definition of the Momphidae and Walshiiidae (Lepidoptera: Gelechioidea). *Entomologica Americana* 42: 1-166.

———. 1978. Fascicle 6.1 Gelechioidea, Cosmopter-

igidae. In *The Moths of America North of Mexico*. E. W. Classey Limited and The Wedge Entomological Research Foundation, London. 166 pp.

Peterson, A. 1948. *Larvae of Insects. An Introduction to Nearctic species. Part 1. Lepidoptera and Plant Infesting Hymenoptera*. Published by the author, Ann Arbor, Michigan. 315 pp.

Sinev, S. Y. 2002. World catalogue of cosmopterigid moths (Lepidoptera: Cosmopterigidae). Russian Academy of Sciences, Proceedings of the Zoological Institute, St. Petersburg 293: 1-183.

Stehr, F. 1987. Cosmopterigidae (Gelechioidea), pp. 391-392. In Stehr, F., ed. *Immature Insects, Volume 1*. Kendall/Hunt Publishing Company, Dubuque, Iowa, 754 pp.